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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/820,079	03/28/2001	Grant Kloster	42390P11026	4031
8791	7590	05/26/2006		
BLAKELY SOKOLOFF TAYLOR & ZAFMAN 12400 WILSHIRE BOULEVARD SEVENTH FLOOR LOS ANGELES, CA 90025-1030			EXAMINER LOKE, STEVEN HO YIN	
			ART UNIT 2811	PAPER NUMBER

DATE MAILED: 05/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/820,079

Applicant(s)

KLOSTER ET AL.

Examiner

Steven Loke

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 20 March 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,3-10,12-14,16-20 and 28-34 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,5-7,9,10,12-14,16-20,31 and 32 is/are rejected.
- 7) ☒ Claim(s) 3,4,8,28-30,33 and 34 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

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1. In view of the appeal brief filed on 3/20/06, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 5-7, 9, 10, 12-14, 16-19, 31 and 32 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Chen et al.

In regards to claim 1, Chen et al. show all the elements of the claimed invention in fig. 7. It is a microelectronic device and it has a structure on a substrate [11]. The structure comprising: a diffusion barrier layer [24] disposed above and on the substrate [11], the diffusion barrier layer (silicon nitride) having a first thickness (300 angstroms) and a first dielectric constant (7.5), wherein the first thickness comprises a range from about one atomic monolayer to about 1000 angstroms; an etch stop layer [30] (SILK) above and on the diffusion barrier layer [24], the etch stop layer having a second thickness (7000 angstroms), and a second dielectric constant (2.6); and an interlayer dielectric (ILD) layer [34] (silicon oxynitride) (dielectric constant of silicon oxynitride is 5.5 and the thickness of layer [34] is 1000 angstroms) disposed above and on the etch stop layer [30], wherein the structure has an effective dielectric constant in a range less than about 3 (the effective dielectric constant is about 2.85).

The effective dielectric constant ( $k_{eff}$ ) of the structure is calculated by the formula  $k_{eff} = d_{total} / [(d_1/k_1) + (d_2/k_2) + (d_3/k_3)]$ , where  $d_1$  = thickness of layer [24],  $k_1$  = dielectric constant of layer [24],  $d_2$  = thickness of layer [30],  $k_2$  = dielectric constant of layer [30],  $d_3$  = thickness of layer [34],  $k_3$  = dielectric constant of layer [34],  $d_{total}$  = total thickness of layers [24, 30, 34]. Substituting values disclosed by Chen et al. in the equation, the effective dielectric constant is less than three (about 2.85).

In regards to claim 5, Chen et al. further disclose the diffusion barrier layer [24] comprises an inorganic composition (silicon nitride) and wherein the etch stop layer [30] comprises an organic composition (SILK).

In regards to claim 6, Chen et al. further disclose the etch stop layer [30] comprises an organic composition (SILK) and wherein the diffusion barrier layer [24] is silicon nitride.

In regards to claim 7, Chen et al. further disclose an electrically conductive trace [20] disposed in the substrate [11]; and a contact [50] disposed in a recess that extends through the ILD layer [34], the etch stop layer [30], and the diffusion barrier layer [24], and wherein the contact makes an electrical connection to the trace [20].

In regards to claim 31, Chen et al. further disclose the second thickness (7000 angstroms) is greater than the first thickness (300 angstroms).

In regards to claim 32, Chen et al. further disclose the second thickness (7000 angstroms) is at least about 10 times as thick as the first thickness (300 angstroms).

In regards to claim 9, Chen et al. show all the elements of the claimed invention in fig. 7. It is a microelectronic device and it has a structure on a substrate [11]. The structure comprising: a substrate [11] having an upper surface; an electrically conductive trace [20] in the substrate; a diffusion barrier layer [24] disposed above and on the substrate and the trace, wherein the diffusion barrier layer [24] comprises a thickness (300 angstroms) in a range from about one atomic monolayer to about 1000 angstroms; an etch stop layer [30] above and on the diffusion barrier layer [24]; and an ILD layer [34] disposed above and on the etch stop layer [30], wherein the diffusion barrier layer [24] (silicon nitride) (inorganic composition) and the etch stop layer [30] (SILK) (organic composition) are mutually exclusively selected from either an organic composition or an inorganic composition.

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In regards to claim 10, Chen et al. further disclose the trace [20] surface is coplanar to the upper surface.

In regards to claim 12, Chen et al. further disclose the ILD layer [34], the diffusion barrier layer [24], and the etch stop layer [30] have an effective dielectric coefficient (about 2.85) less than about 3.

In regards to claim 13, Chen et al. further disclose the ILD layer [34], the diffusion barrier layer [24], and the etch stop layer [30] have an effective dielectric coefficient of about (near) 2.8.

In regards to claim 14, Chen et al. further disclose the ILD layer [34], the diffusion barrier layer [24], and the etch stop layer [30] have an effective dielectric coefficient in a range from about (near) 2.6 to about (near) 2.8 (2.85 is near 2.8).

In regards to claim 16, Chen et al. show all the elements of the claimed invention in fig. 7. It is an article of manufacture, comprising: a semiconductor substrate [11]; a first dielectric layer [24] disposed on the semiconductor substrate, wherein the first dielectric layer comprises a thickness (300 angstroms) in a range from about one atomic monolayer to about 1000 angstroms; an etch stop layer [30] disposed above and on the first dielectric layer; an interlayer dielectric (ILD) [34] disposed on the etch stop layer; and a conductive damascene article [50, 60] (col. 7, lines 15-17), wherein the conductive damascene article is in electrical contact with the substrate, the conductive damascene article is also in contact the first dielectric layer [24], the etch stop layer [30], and the ILD layer [34]; and wherein the first dielectric layer [24] (silicon nitride) is an inorganic composition and comprises a material selected to be a diffusion barrier to

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prevent diffusion of material of the conductive damascene article into the substrate [11] (silicon nitride inherently blocks the diffusion of TaN into the substrate because all electrical insulating materials would block the electrical connection between a metal and a semiconductor substrate), and wherein the etch stop layer [30] (SILK, FLARE) is an organic composition.

In regards to claim 17, Chen et al. further disclose the first dielectric layer [24] is silicon nitride.

In regards to claim 18, Chen et al. further disclose the etch stop layer [30] is arylene ether polymers (FLARE).

In regards to claim 19, Chen et al. further disclose the etch stop layer [30] (SILK) has a dielectric constant (2.6) in a range of less than about 2.8.

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. in view of Bains.

In regards to claim 20, Chen et al. differ from the claimed invention by not showing the etch stop layer has a dielectric constant in a range of about (near) 2.

Bains discloses that IBM produces a porous organosilicate dielectric material of dielectric constant equal to 2.2.

Since both Chen et al. and Bains disclose a low-k dielectric for a multilevel wiring structure, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize an organosilicate material with pores to attain a low k etch stop layer for use in forming damascene interconnects because it further reduces the capacitance in the wiring structure.

6. Applicant's arguments filed 3/20/06 have been fully considered but they are not persuasive.

It is urged, in pages 11-12 of the appeal brief, that the dielectric layer [30] in Chen is not an etch stop layer. However, the SILK layer [30] of Chen stops an etch process used to etch a layer [34] above the SILK layer (etch stop layer) [30] from affecting the layer [24] below the SILK layer [30]. Since the SILK layer [30] stops the etching process, the SILK layer [30] is considered as an etch stop layer.

It is also urged that Chen fails to disclose or suggest an ILD layer above an etch stop layer as recited in claim 1. However, Chen does show an ILD (interlayer dielectric) [34] (silicon oxynitride) above the etch stop layer [30].

It is urged, in pages 17-18 of the remarks, that Chen fails to disclose a diffusion barrier layer on a substrate, an etch stop layer on the diffusion barrier layer, and an ILD layer on the etch stop layer, as is recited in claim 16. However, Chen does show a diffusion barrier layer [24] on a substrate, an etch stop layer [30] on the diffusion barrier layer, and an ILD layer [34] on the etch stop layer in fig. 7. Chen also shows each of the limitations as claimed in claims 17-19. The combination of Chen and Bains also shows the limitation as claimed in claim 20.



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7. Claims 3, 4, 8, 28-30, 33 and 34 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter: The first major difference in the claims not found in the prior art of record is the diffusion barrier layer comprises an organic composition and the etch stop layer comprises an inorganic composition. The second major difference in the claims not found in the prior art of record is the diffusion barrier layer is selected from arylene, parylene, arylene ether polymers, and fluorinated polyimides. The third major difference in the claims not found in the prior art of record is the contact is a single-damascene contact article. The fourth major difference in the claims not found in the prior art of record is a first recess in the ILD layer with a first width and extending from a bottom surface of the ILD layer up to a position partway through the ILD layer; and a second recess in the ILD layer with a second width wider than the first width and extending from the top of the first recess to the top of the ILD layer. The fifth major difference in the claims not found in the prior art of record is the ILD layer has a third thickness, and the third thickness is greater than the second thickness. The sixth major difference in the claims not found in the prior art of record is the ILD layer has a third thickness, and the third thickness is at least about 5 times as thick as the second thickness. The seventh major difference in the claims not found in the prior art of record is the ILD layer has a third thickness; the third thickness is at least about 5 times as thick as the second thickness; and the second thickness is at least about 10 times as thick as the first

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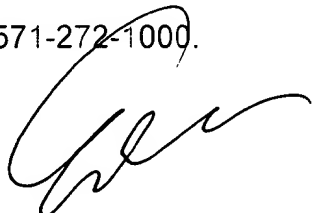
thickness. The eighth major difference in the claims not found in the prior art of record is the ILD layer comprises a carbon doped oxide and has a third thickness, and the third thickness is at least about 5 times as thick as the second thickness.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven Loke whose telephone number is (571) 272-1657. The examiner can normally be reached on 8:00 am to 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

sl  
May 23, 2006



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